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AUTHOR Cox, William F., Jr.
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ABSTRACT

The effect of using either abstract or concrete words on verbal problem solving was examined in this study. Twelve undergraduate students in each of two conditions mentally solved identically structured problems by reordering and chaining together previously memorized pairs of words. Subjects who received concrete words both memorized the word pairs and solved the problems in less time than did subjects who received abstract words. Superior performance associated with concrete words was discussed in relation to the facilitating effect of imagistic encoding compared with verbal encoding. (Author/AA)

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Problem Solving as Influenced by Concrete and Abstract Stimulus Words

William F. Cox, Jr.

The University of Toledo

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WILLIAM F. COX, JR.
University of Toledo

ABSTRACT

The effect on verbal problem solving from using either abstract or concrete words was examined. Twelve undergraduate students in each of the two conditions mentally solved identically structured problems by reordering and chaining together previously memorized pairs of words. Subjects who received concrete words both memorized the word pairs and solved the problems in less time than did subjects who received abstract word pairs. Superior performance associated with concrete words was analyzed in relation to the facilitating effect of imaginal over verbal encoding. Implications were discussed regarding both educational and psychological issues.

Problem Solving as Influenced by Concrete and Abstract Stimulus Words

William F. Cox, Jr.
Dept. of Educational Psychology
College of Education
University of Toledo
Toledo, Ohio 43606

WILLIAM F. COX, JR.
University of Toledo

OBJECTIVE

A substantial body of research indicates that stimulus attributes influence learning but little if any research is directed toward the influence of stimulus attributes on utilizing items once they are learned, as in problem solving tasks. The main objective of this study was to investigate the possibility that problem solving activities are also influenced by those stimulus attributes thought to influence memorization.

PERSPECTIVES

By definition, the act of problem solving is typically conceptualized as the combining of two or more items, principles, etc. to reach some goal state. This act is evidently constrained by the capacity of the operational memory component of short term memory to actively reinstate and process information (Posner, 1967, 1973). Even for highly accomplished thinkers, the collective recalling and combining of memory components poses a serious limitation on cognitive processing (Hunter, 1964).

Hayes (1965), in requiring subjects to solve problems by chaining together facts previously committed to memory, noted that a phase of performance was facilitated by cognitive planning -- a function of operational memory. Other researchers have suggested that various memory techniques including the use of visual imagery can expand our information processing capacity (Bower, 1970; Miller, 1956).

That mental mnemonics facilitate learning is hardly a matter for debate. Numerous studies have amply demonstrated that the paradigmatic task of learning paired associates is enhanced either through verbal or pictorial memory aids. Paivio has suggested that verbal processes are preferred for learning abstract noun pairs and that the combination of verbal and imagery processes are preferred for learning concrete noun pairs. However, visual imagery, when readily available, seems to be more effective than verbal mediation perhaps due to "richness" of the coding and ease of retrieval (Paivio, 1971). Additionally, the imagery/concreteness property of stimulus words to evoke mental strategies is relatively more powerful than are other stimulus properties such as meaningfulness and organization.

METHODS

To test the possibility that stimulus attributes (i.e. concreteness-abstractness associated with verbal and imaginal memory processes are of differential effectiveness for problem solving, as well as memorization tasks, each of the two groups of subjects received either abstract or concrete word pairs to memorize and then rearrange to solve problems of matched, identical structures.

Twenty-four students from a freshman teacher education class at The University of Toledo were randomly assigned to a concrete or an abstract experimental condition.

Subjects received four different paired associate problems of either abstract or concrete words, depending on the experimental condition. Selected from the Paivio, Yuille, & Madigan (1968) list, concrete words were valued no less than 6.69 on a 7-point scale of concreteness whereas the abstract words rated no higher than 2.82. Additionally, on the Paivio et al. 7-point scale for meaningfulness, concrete words ranged from 5.12 to 7 and the abstract words from 4.17 to 7.00. All words were in the A or AA frequency category (50 and 100 per million, respectively).

Each of the four problems were defined by their "solution chain" length, i.e., the number of word pairs structurally linked by mutually shared words (e.g., vegetable-hotel, hotel-animal, etc.). The four problems thus had a solution chain length of 4, 6, 8 and 10 pairs. For the 4, 6, & 8 pair solution chain, additional noninterconnected pairs were added to produce a constant 10-pair list for the subject to memorize.

Using a spy game setting in which each word pair represented spys who could jointly communicate, each subject was individually presented with the 10 pairs of words to memorize to three error free trials. (The pairs were randomized to conceal the problem structure.) Subjects were then required to reorder the word pairs from memory to get a message from the initial through the appropriate network of connecting spys (i.e., words) to the goal spy. (Differential difficulty in solving problems would assumedly be associated with length of the inherent structure or solution chain.) This procedure was followed for the one practice problem and for each of the 4 problems which were presented in a random sequence.

A 2 (Experimental Condition) x 4 (Problem) repeated measures design was used. A 2 x 4 analysis of variance was computed on the two dependent measures: time to memorize and time to solve the problem.

RESULTS AND CONCLUSIONS

For the memorization measure, abstract words took significantly longer to memorize than concrete words; a finding consistent with other related studies. However, memorization times for word lists of different problem types did not differ significantly. Similarity of memorization times for different problem types suggests that subjects were not isolating and memorizing the hidden solution chain in preparation for the problem solution phase but rather were memorizing the word pairs in the order presented.

For the problem solution measure, which was the major focus of the study, a significantly greater amount of time was required to solve (as also to memorize) abstract word problems than concrete word problems. Additionally, and perhaps most importantly, significantly greater times were recorded for problems of succeedingly longer solution chains. No significant interactions occurred. A comparison of solution time to solution chain length indicated a direct, proportional relationship of solution time to length of problem chain (i.e., problem type).

The results indicate that the abstractness-concreteness values of stimulus words affect problem solving as well as memorization performance. In terms of the supposed capacity (7 ± 2) of short term or operational memory, the lack of any word type - problem type interaction and the proportional solution time to solution chain relationship gives no indication of any restrictions imposed by cognitive processing limitations to account for differences in problem solution times.

A more reasonable explanation of superiority of concrete words over abstract words (under equal memorization criteria) relates to the availability of encoded items from memory. Paivio (1971) indicates that while availability of verbal encoding occurs somewhat equally for both concrete and abstract words, there is an additional effect of imagery availability for concrete words that is not present for abstract words. While experimenter reports in this study do not indicate a prevalent use of any one type of memory strategy by subjects, it did seem that subjects receiving concrete words were more vocal in recognizing that they used some memory technique other than rote memorization. Obviously, subsequent research needs to document whether item concreteness per se facilitates problem solving or whether item concreteness fosters strategy utilization which in turn facilitates problem solution processes.

EDUCATIONAL AND SCIENTIFIC IMPORTANCE

This study thus points the way, in some sense, toward scientifically examining stimulus attributes and memory techniques (currently popular with the lay public) and their hitherto neglected role in problem solving performance. An immediate educational implication is that, where content permits, abstract problems might better be cast into concrete terms to aid reorganization and manipulation of the elements.

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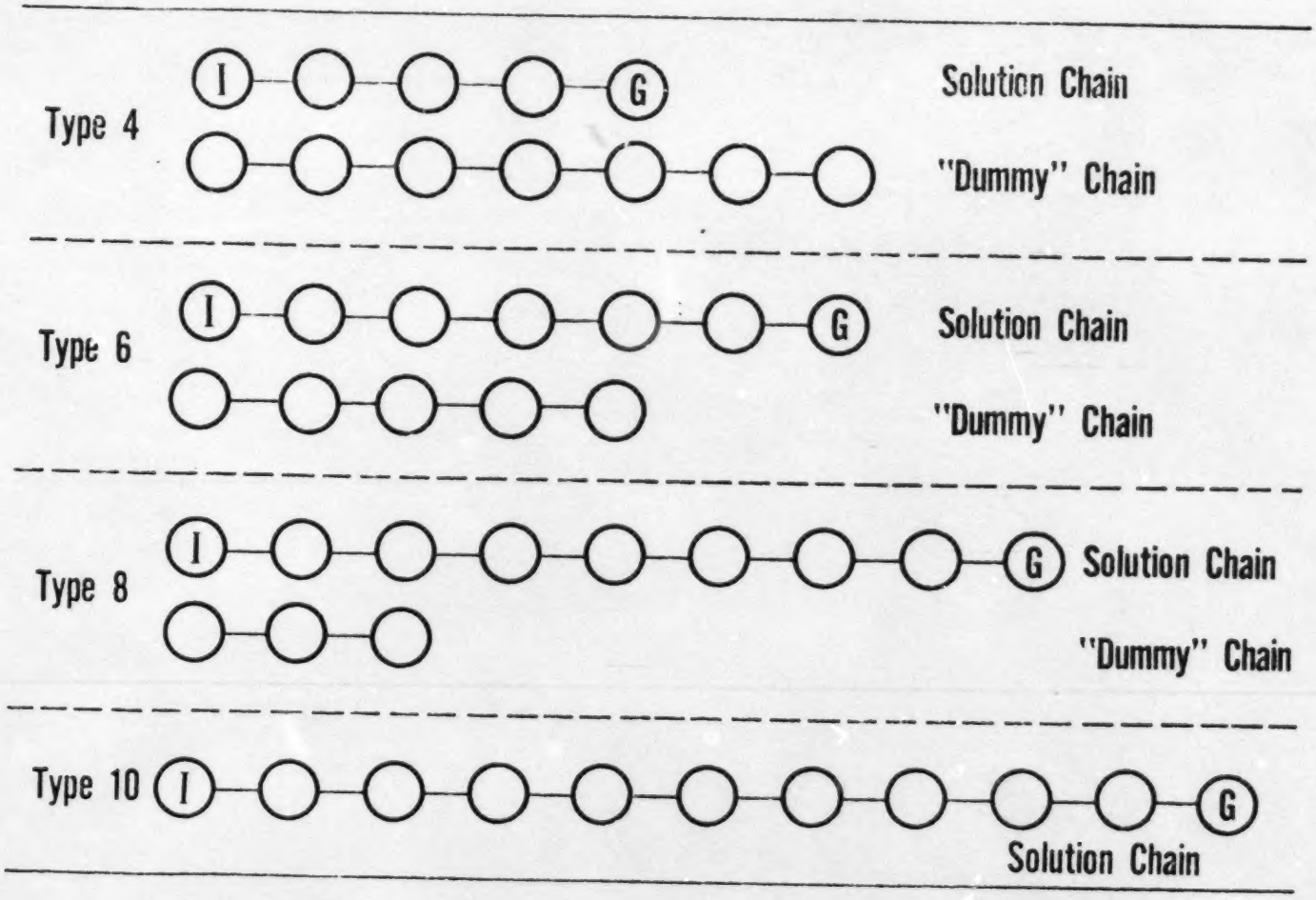
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